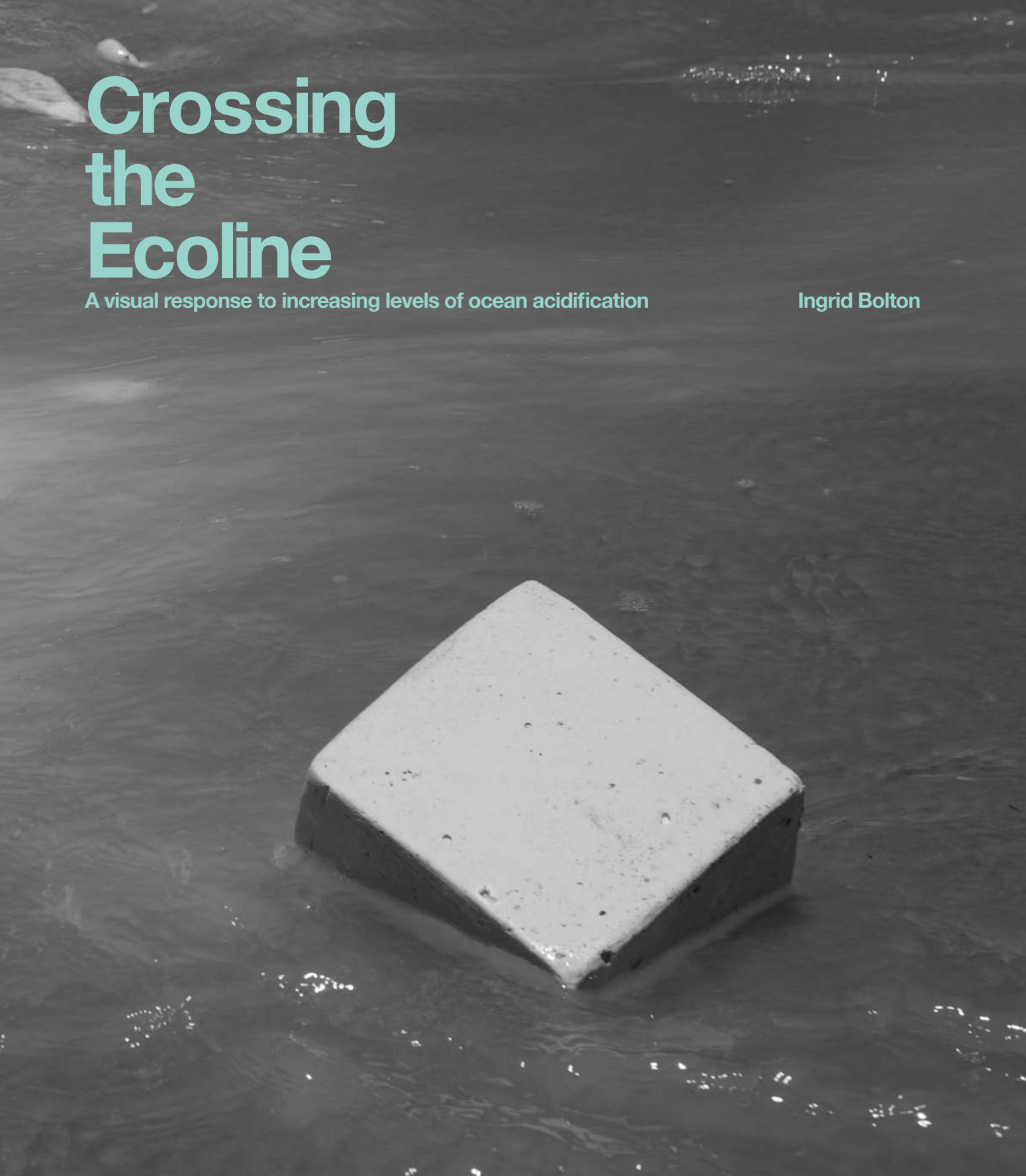

Crossing the Ecoline

A visual response to increasing levels of ocean acidification

Ingrid Bolton

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University of Cape Town

Crossing the Ecoline

A visual response to increasing levels of ocean acidification

Ingrid Bolton

Michaelis School of Fine Art
Faculty of Humanities
University of Cape Town

In partial fulfilment of the requirements for a Master of Fine Art degree.

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Abstract

This text is presented in conjunction with my exhibition *Crossing the Ecoline* and is a visual response to changing levels of ocean acidification. My art making is informed by the processes of dispersal and dissolution that occur at the point where the absorption of carbon dioxide takes place between the atmosphere and the ocean. This project is of an interdisciplinary nature and traverses art and science – both technically and through collaboration. By working in close consultation with marine scientists I hope to draw attention to the little-known issue of ocean acidification through creative means. Through the consideration of materials and processes I aim to bring attention to where billions of microorganisms called phytoplankton live. The project is concerned with the idea of the edge: boundary or border as a conceptual notion, as well as through my art making practice, its interdiscplinarity and subject matter.

Preface

A part of my lived experience was farming. My husband and I, together with our two young children, moved to a farm in the Franschhoek valley. It was predominantly a fruit farm, but also had some guest cottages. Notwithstanding the fact that I had no farming experience, it fell on me to manage the day-to-day activities. We took over a farm that had great character but had been conventionally farmed for many years. After witnessing the impact of pests and disease and the continued need to spray insecticides and herbicides, we looked to alternative methods of farming. We converted to organic methods with an emphasis on producing our own compost and avoiding the use of chemicals. After some time we grew organic vegetables, had hens that provided us with fresh eggs and a friendly beekeeper who traded honey with us. We supplied families and a restaurant with vegetable boxes filled with our produce.

So it was farming that focused my attention on the weather. It was during this period that I first became intimately aware of weather and climate patterns. In these early farming days we experienced El Nino conditions that resulted in an unusually dry cycle.[1] There were four dams on the property and we were told that they would “fill up” over winter – the rainy season in the Western Cape – and the crops would be irrigated from the dams for the rest of the year. However, for the first three years the dams did not fill; when it did rain, I scurried up the mountain in my gumboots, spade in hand, to divert the flow of water in the direction of our farm dams. Through exposure to farming and these adverse weather conditions, I grew to have a greater respect for the land and learnt to observe closely how we are integrally connected to the land and rely on it for food production: what we do on and around the land will have consequences for future generations.

1 According to the South African Weather Service (online), 1997/98 was the strongest El Nino event of the last century, although it also mentioned that South Africa “... escaped the impact of it to some extent”. As new farmers it certainly did not seem that we escaped much.

Figure 1.
Cavolinia longirostris

Figure 2.
Cavolinia inflexa

The author Nancy Spector maintains that "… artistic expression should reflect the complexity of a life lived, take account of the myriad events – both significant and seemingly trivial – that occur and are then forgotten, only to be recalled again in altered form " (1996: 42). Spector looks closely at how the artist Felix Gonzalez-Torres "invokes Rainer Maria Rilke's notion of blood remembering", where an event becomes not simply a memory, but becomes a part of oneself (Spector 1996: 42).[2] My blood memories of farming feed my artistic practice today. It is my attempt to answer the questions that were formulated then, in the form of environmental awareness. A previous career in microbiology has also become part of my blood memory, fuelling my interest in microorganisms. The seeds cast then by my interaction with nature and in the laboratory play out in my current art making.

2 Although the context of this quote is different, I am using it because I agree with Maria Rilke that our lived lives inform what we have become and in my case it informs my art making.

"There is a fine line between eco-art and activism"
(Lippard 2011: 13) – and my art travels along that line.

Introduction

Anthropogenic climate change is well documented in the public arena – anthropogenic being that which is as a result of human activity, and climate[3] change being a state where there is, over an extended period, "a statistically significant variation in either the mean state of the climate or in its variability" (Dow & Downing 2006: 15). This change in climate is due in large part to the emissions of various gases into the atmosphere through the burning of fossil fuels like coal and oil, and the predominant gas emitted is carbon dioxide. Yet what is not so well documented is ocean acidification, which has now become known as the "other climate change" problem (PMEL: online). The Pacific Marine Environmental Laboratory (PMEL) describes it as follows: The ocean has always absorbed carbon dioxide gases, but, because the levels of carbon dioxide in the atmosphere have been rising since the industrial revolution, more carbon dioxide has been absorbed into the oceans. As a consequence the ocean has become unnaturally acidic and its calcium carbonate concentrations – a compound that is essential for skeletal and shell production in marine animals – are being reduced. This ocean acidification is having a profound impact on microscopic organisms, in particular those that don't thrive in a more acidic environment. Some of these organisms exist at the bottom of the oceanic food chain and so have a knock-on effect on the creatures we eat, like fish and molluscs, which more than a billion people rely on as a source of protein (PMEL).

3 Climate is an accumulation of many years of weather, more than a single season or period is required to be classified as change (Mann & Kump 2008: 10).

Field biologists describe the ecocline[4] (or ecotone) as that place where two boundaries or environments come together and intersect: a place where there is the possibility of an encounter between living inhabitants of different environments and, in this case, certain chemical compounds, which may react or interact. The physical spaces or ecoclines that I explore are where the ocean intersects with the shoreline and where the ocean meets the atmosphere. The encounter that I highlight in this space is that between carbon dioxide and tiny marine organisms called phytoplankton. My focus is specifically on a group of organisms called pteropods, commonly known as the sea snail or sea butterfly. *Ptero* refers to the wing and *pod* to the foot (Plankton chronicles: online). This organism has a delicate translucent shell and moves through the water by using its feet as wings. On my first reading of the word ecocline, I misread it as "ecoline", a word that I have chosen to retain. I include this neologism in my title because it not only speaks of a fragile boundary that humankind may be overstepping, but also references my particular concerns and interests. Physically, a line is found at the edge or boundary, separating; yet when there appears to be a separation, in reality there is often still a connection through the boundary. Thus, the line denotes both separation and connection. It is this interconnectedness that interests me. The "ecoline" or environmental boundary in this text can simultaneously be considered to be a straight "line" (the horizon) or the constantly breathing surface of 335 258 000 square kilometres[5] of ocean, depending on one's perspective at the time of observation.

Through my initial conversations with scientists in the field I learnt that the pteropod (Figures 1 & 2) or sea snail was, amongst others, a "poster child" for ocean acidification due to the deterioration of its fragile translucent shell as a result of increased acid levels in the ocean. I was also pointed in the direction of an engineering company that operates a fleet of unique vessels that monitor the oceans in South Africa. Their *ocean glider* is an autonomous marine vessel that can be sent on a specific course into the ocean for months at a time, monitoring and relaying test results of water analysis to the researchers on land. The glider moves on the surface of the water, the ecocline, the space between the water and the air. The results obtained from the ocean glider reveal the relationship between carbon dioxide in the air and the water. How some creatures that live in the sea, like the pteropod, are and will be affected by changing acid levels is projected through analysis of the data.

4 A cline from one ecosystem to another, showing a continuous gradient between the two extremes.

5 www.worldatlas.com

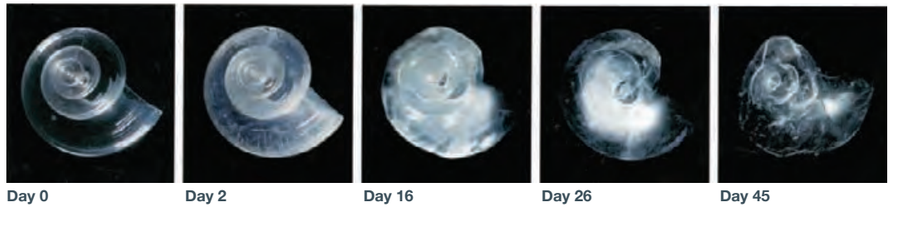

Figure 3. If levels of acidification are left unchecked.

If levels of acidification are left unchecked, the figure above demonstrates the sequential destruction of the pteropod shell over 45 days in a controlled environment.

In the following pages I will define and explore the contemporary practice of ecoart, which is the field in which I situate my production. I will look at how the work of past environmental and activist artists like Agnes Denes and Buster Simpsons has been pivotal in the lead up to what has now become known as ecoart, and also look at how artists such as Sabrina Raaf and writers such as Carolyn Merchant, Nancy Spector and Pamela Lee influence thinking around environmental issues and, by implication, my own work.

I will also investigate the juxtaposition of black and white in my work, as well as my processes of dispersal and dissolution. This is followed by a discussion of ether, the unseen hand that affects the globalised world of today and is particularly relevant to the causes of climate change, and indirectly to ocean acidification. I traverse two positions throughout this text – literally, in the physical space, and metaphorically, in the gallery. I hope to create awareness about this global acidic shift, as it is my attempt to answer the question asked by professor of environmental history, philosophy and ethics, Carolyn Merchant and academic Jennifer Wells: what specific contributions can artists make to raise public awareness about climate change (Merchant & Wells 2009: 16)? Together, Merchant and Wells raise significant issues that the humanities can address and discuss how they can engage with the complex problem of climate change. One of the four intersecting themes they address is climate change and the arts.[6] They also examine the question of what steps can be taken towards finding solutions to the environmental problems that humanity is facing now, which is why I attempted to answer the question above (2009: 25).

6 The other themes, which I will not be looking at in detail but which are nonetheless linked, are climate ethics, climate justice and climate change and religion.

The Earth Charter is an organisation that provides an ethical framework for how we build a global society and that takes into account future generations. They describe humanity's current situation:

> We stand at a critical moment in Earth's history, a time when humanity must choose its future. As the world becomes increasingly interdependent and fragile, the future at once holds great peril and great promise. To move forward we must recognize that in the midst of a magnificent diversity of cultures and life forms we are one human family and one Earth community with a common destiny. We must join together to bring forth a sustainable global society founded on respect for nature, universal human rights, economic justice, and a culture of peace. Towards this end, it is imperative that we, the peoples of Earth, declare our responsibility to one another, to the greater community of life, and to future generations.
>
> (The Earth Charter: online)

In my work I make every attempt to use materials and processes that are not harmful to the environment. The compound calcium carbonate, a primary component of my work, will be recycled back into the ocean. The process of moulding leaves no waste, as, by combining it with water only, any excess or rejected pieces can be reconstituted to make new forms. Video also leaves minimal waste. I will complete one of the works only after the exhibition has ended and so, by integrating the future into the work, time also becomes one of my materials.

Eco art

Eco: connected with the environment.[7]

In her text *Ecological Art: A Call for Visionary Intervention in a Time of Crisis,* artist Ruth Wallen (2012) not only defines ecoart (or ecological art), she also positions it firmly in the contemporary art world:

> Drawing on broad interdisciplinary knowledge and appealing to both heart and mind, ecological art is grounded in an ecological ethic and systems theory, addressing the web of interrelationships between the physical, biological, cultural, political and historical aspects of ecosystems. Asking probing questions, fashioning potent metaphors, identifying patterns, weaving stories, offering restoration and remediation, inventively using renewable materials and re-envisioning systems, ecological artists inspire, advocate and innovate, revealing and/or enhancing ecological relationships while modelling ecological values. Ecological art inspires caring and respect for the world in which we live, stimulates dialogue, speaks imagination and contributes to the social-cultural transformations whereby the diversity of life forms found on earth may flourish. (Wallen 2012: 235)

I place my work within this context of ecoart primarily because of the interconnectedness of what I am looking at, the place that it occurs and what it is that is occurring. I present the link between art and science visually, the relationship of humans to the environment, how microscopic phytoplankton are embedded in the food chain and how carbon dioxide emissions caused by humans changes the climate and acidifies the oceans. I do this by

7 http://www.oxforddictionaries.com/definition/learner/eco

bringing attention to the place where this happens, the ecocline. Linda Weintraub, artist, author and educator, takes it one step further when she says that “Interconnection is the inescapable law of links and relationships that govern all materials, all processes and all events on Earth” (2012: 6).[8]

Ecoart follows earlier movements in art that engaged with the environment, like land art and ecofeminism. In *Radical Ecology* (1992), Carolyn Merchant writes extensively about the relationship that humans, especially women, have had with the environment. During the 1970s the connections and increased consciousness of women to the land and nature was described by the term ecofeminism. Typically women were associated with nature, men with culture and thus control and domination over nature by humans was associated with patriarchal control.[9] Liberation of both women and nature became a goal in the United States later in the 1980s (Merchant 1992: 184,185).

Land art, a broad term that was more specific when it was first used in the late 1960s and early 1970s, referred to art that was made on the land in a specific place, often using local natural materials. The term has since evolved to include, amongst others, earth art or art in nature or even ecoart. Environmental art has become an umbrella term for many types of this practice and much of it highlights a specific problem with the land or site, bringing awareness to the problem – in so doing the artist frequently becomes an environmental activist. Artists like Agnes Denes, Hans Haacke and Joseph Beuys have

8 In *To Life! Ecoart in Pursuit of a Sustainable Planet*, Weintraub (2012) looks at ecoart in detail by revealing artists’ responses to the environmental challenges of the contemporary art world. She feels that artists have the ability to transform, reform and inspire, through their work, due to their “astute communication skills” and respond to the climate crisis of the current era (2012: xiii).

9 This approach received criticism from some feminists due to the essentialist position that ecofeminists capitalised on, which linked nurture by mothering and nature.

asked questions about human interaction with the land and its future in our hands. The author John Beardsley describes how artists during this period reinvented the traditional genre of landscape: “They were not depicting the landscape, but engaging it: their art was not simply of the landscape, but in it as well” (Beardsley 1984: 7). Beardsley explains that the works were intricately linked to the site or place of their construction and that the work and viewer experience was uniquely linked to that specific site. Artists sought an alternative to the white cube gallery space and took their work outside into the natural environment to engage with the land.

The contemporary burden of art that engages with the environment today is predominantly related to concern for and preservation of the environment. The current problem of climate change is of such a magnitude that curators and artists now produce exhibitions specifically themed around environmental and climate concerns. Wallen recognises that whilst some of the major ecological exhibitions[10] understand the need for urgency in dealing with the ecological crisis, the strategy of alarmist documentation and devastation may not elicit an effective audience response. As the land artists found different ways of working in the environment in the 1960s, so too can contemporary artists find different ways of working with the concerns of climate change. She suggests that further consideration could be given to the individual species rather than the more general ecosystem concept, which has more of a holistic approach (Wallen 2012: 238). Wallen also warns of the championing of charismatic species. However, while I find my pteropods charismatic, they are a fairly inconspicuous species.

10 One such exhibition, *Ecovention: Current Art to Transform Ecologies,* proposed the new term, ecovention combining the words ecology and intervention. This was used to describe “ an artist-initiated project that employs an inventive strategy to physically transform a local ecology.” (greenmuseum.org:online)

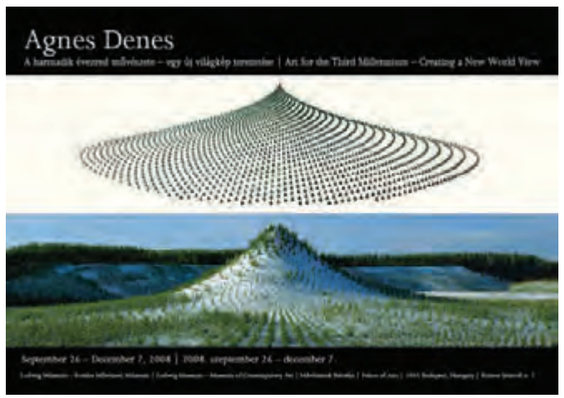

Figure 4. Agnes Denes. 1982-1995. *Tree Mountain.*

Figure 5. Sabrina Raaf. 2004–2006. *Translator II: Grower.*

The exhibition *Radical Nature* (2009) at the Barbican Gallery was the first exhibition to showcase work by artists who had worked with environmental issues during the preceding forty years. Ideas that "emerged out of land art, environmental activism, experimental architecture and utopianism" were explored through the exhibition (Barbican: online).

One of the works in this exhibition was a collaborative project between the artist Agnes Denes and the public. *Tree Mountain* (1982-1995, Figure 4) showed that it was not only specific to the site in Finland, but brought 10 000 people together to plant 10 000 silver fir trees. It also revealed the growth of trees that had been planted years before, showing change over the time that had passed. The trees have a lifespan of up to four hundred years and "ownership" of the artwork is in the form of custodianship of the tree planted. The custodianship can be sold or left to heirs, but the forest itself cannot be changed (Denes in Kastner 1998: 262). According to Denes, "The trees must outlive the present era[11] and, by surviving, carry our concepts into an unknown time in the future" (Denes in Kastner 1998: 262). This artwork evokes both the present and the future; the potential growth of the trees over time plays a metaphorically significant role and, having secured the land legally for hundreds of years into the future, signifies permanence and commitment to that specific environment, not just by one person but by a community of people.

The need to record environmental work that is impermanent in its form, like some site-specific work, has necessitated the creation of virtual galleries and exhibitions. Since 2001 the online gallery greenmuseum.org, created by volunteers, has drawn attention

11 Denes manages to make the work sustainable by considering the needs of the following generation. Wallen shows how sustainability considers not only the hard sciences but includes political and economic realities as well (Wallen 2012: 238).

Figure 6.
Times Four, 2016
Installation (Detail)
Shipping pallets, calcium carbonate and coal dust cubes

to the environmental crisis. It is an online platform for collaboration and showcasing ecoart. Curator Andrea Polli describes the online exhibition *AER*: “Most of the featured projects blur the line between art and activism, and all the artists are changing public understanding of the air around us, questioning accepted norms of ownership of and responsibility to the air we must breathe to live” (greenmuseum.org: online).

In one of the works on greenmuseum.org, by Sabrina Raaf, *Translator II: Grower* (2004-2006) shows in figure 5 there can be a mutually interactive relationship between humans and machines. A small robot hugs the periphery of a gallery room and draws fluctuating heights of “grass” along the bottom of wall. By means of a sensor that takes readings every few seconds, the robot reacts to the carbon dioxide (CO_2) levels in the room caused by the exhaled breath of the people who enter the space. The more people in the room, the higher the “grass”.

Raaf’s work makes the CO_2 levels in the confined space of a room visible. The unobserved, odourless vapour is translated into a measurable reference that is instantly recognisable to the viewer. Raaf[12] elects to place her lines at floor level, not using a continuous line but separate short lines, suggestive of growing grass. In addition, the accumulation of people and the amount of CO_2 in the room is made visible by the height of the drawn “grass”. These visual clues present a serious topic in an engaging and creative way, yet there is an underlying tragedy in the synthetic, simulated drawn grass that responds to our production of CO_2 – as much as there is a tragedy to my simulated and reconstructed pteropod shells.

12 Raaf also made the exhaled breath of visitors visual by providing a medium for the bacteria in the breath to grow. The cultures are displayed as well as the microscopic photographs (http://raaf.org: online).

Black and White

Black: Of the very darkest colour owing to the absence of or complete absorption of light.[13]
White: Of the colour of milk or fresh snow, due to the reflection of all visible rays of light.[14]

In discussions about climate change not everything is black and white. By choosing to predominantly use black and white in my work I consciously choose to counter the blurred lines of the climate debate. Technically, this should not be a debate, since 98% of climate scientists agree that current climate change is human made. However, the media gives the 2% who disagree about 50% of the coverage (Gore 2011). By sowing seeds of doubt, big oil and coal companies add to the uncertainty created by the media through campaigns of misinformation, and the production of scientific reports by non-climate scientists (Nixon 2011: 39).[15]

The historic inability of governments to come together and agree on a way forward is highlighted by author Naomi Klein, who points out that since 1990, when formative discussions around climate first occurred, carbon dioxide emissions have increased by 61 per cent (Klein 2014: 11).[16] During COP 21, the 2015 Paris Climate Conference,

13 http://www.oxforddictionaries.com/definition/english/black

14 http://www.oxforddictionaries.com/definition/english/white

15 Nixon (2011) provides an informed understanding of the relationship between big corporate power and climate change. He shows how long-lasting environmental calamities affect the poor and how slow the collective response is to these calamities. He highlights how an element of doubt in the public understanding of climate change is all that is needed to fuel the debate.

16 In *This Changes Everything: Capitalism vs the Climate*, Naomi Klein takes a hard look at how capitalism has a knock-on effect on climate change today. Klein shows that “our economy is at war with all life forms, including human life” (Klein 2014: 18).

important agreements about the reduction of carbon emissions were reached between countries. However, whilst they have been ratified, they will only be ready for signing in April 2016.[17] Accountability is another obstacle to the control or limitation of climate change. Carbon dioxide emissions are a global phenomenon but do not remain within a particular space and the "atmosphere" is not policed or controlled because it has no borders or boundaries. As a result, countries that may be guilty of the highest emissions are not necessarily the first to feel the effects of adverse weather – such as excessive flooding, drought and increased sea levels. Instead, these may be felt by nations that do not emit significant amounts of carbon dioxide into the atmosphere at all. Thus, a country might hypothetically bring its own emissions down to nothing at all but still be adversely affected. Philosopher and environmental activist Peter Singer describes this as being the "…unjust appropriation of one nation of a scarce resource to which that nation has no greater claim than any other nation" (2006: 415). The "resource" he is describing is the atmosphere and its ability to absorb the waste gases without changing the climate.[18]

Having shown that the media's presentation of climate change is contentious, equally the historic presentation of climate change by scientists has not been any more accessible to the public. However, author Stephen Wilson shows that changes are now being seen where art and science interconnect. Artists are recognised as having a positive role to play and are coming together with philosophers, critical theorists and sociologists to question the "idealised vision of science". Wilson (2012: 11) also points out that "artists

17 UNFCC outlines the agreements, but for a more critical look at this see George Monbiot (2015), who questions the agreements that were reached at the COP21 conference.

18 The moral dilemma of global accountability is discussed further by Singer (2006) in his text *Ethics and Climate Change: Commentary.* Singer feels that industrialised nations should be more accountable for their emissions and be reducing them even further.

also invent ways to visualise research results and make investigative processes public and their priorities may or may not match those of scientific researchers. Artists may seek to add a critical dimension with which to view research or introduce totally new agendas." Some interdisciplinary work is already being done between art and science; my challenge is to take this further to elicit a creative understanding or cognition of climate change and, more specifically, ocean acidification. Another author, Barbara Maria Stafford, describes the interaction well (in Elkins 2008: 31).

> Let me be clear: the task is not about making art do science, or vice versa. Rather, interaction happens at the defining "edge". My hope is that isolated research in both domains on what, from a new media perspective is called the "hypertext" remixing, or, from a neurological perspective, the automatic resorting, of our sensory experience in the construction of a private self will lead to a new understanding of human interiority.

My work, like Stafford's words, is not about trying to have art and science become something they are not; in my art-making process I rely on the data and scientists' interpretation of that data to inform my work. Whilst I am working as an artist, my artwork stems from my previous career in microbiology, hence my concern with microorganisms. Although I had an interest in the area of climate change and ocean acidification, it was through conversations and interaction with scientists and engineers that I began to look specifically at the pteropod and the ocean glider. My production is constantly mediated by these ongoing conversations and the research of these scientists. The choice of the material calcium carbonate, being depleted in the oceans through carbon dioxide emissions, also stemmed from those initial conversations.

One of the other materials I use is coal dust; a more refined version would be used by power stations to generate electricity. Juxtaposed against the smooth pure white of the calcium carbonate is the deep black colour of the coal. My choice of coal was guided by two issues: the first that its burning is a major source of carbon dioxide emissions, the second that South Africa has committed to completing two new coal-fired power stations in the next few years. I also reference coal as our country generates 93% of our electricity from this type of power station (Eskom).[19]

The graph in figure 8 shows the amount of carbon dioxide measured at Cape Point in parts per million over the past seven years. In my work *Ecoline* (2016), I re-imagine this line that shows the escalation of carbon dioxide in the atmosphere, however, my line is comprised of many individual "bones". The bones are made of porcelain, a fragile and delicate medium, with the line describing the increase in carbon dioxide levels. Each bone is individually pinned to the wall, resembling a specimen in a museum collection. Many bones make up the whole. Presented in close proximity to this graph is a single museum specimen of a pteropod shell from the collection of Iziko Museums of South Africa. The relationship of the singular shell to the multiple bones speaks to the individual, typological exemplar within the specimen collection and the generalised mass that it represents. Similarly, in my work I draw attention to the enormities of climate change by focusing on a singular species.

19 Initial plans to build a second nuclear power station to support our existing Koeberg Power Station have been reported in the media. However, exact details and the financing of the project are yet to be finalised.

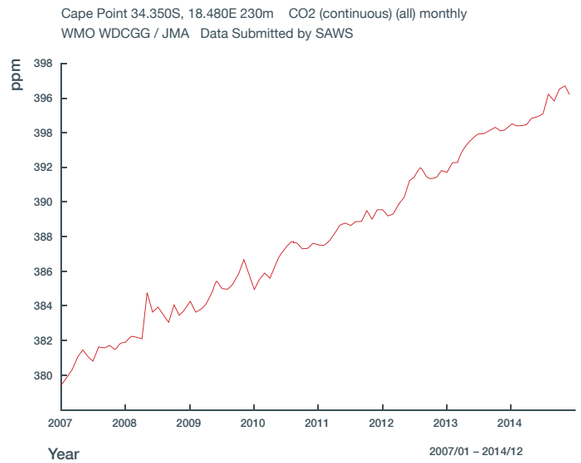

Figure 8. CO2 readings taken at Cape Point, measured in parts per million. (World Data Centre for Greenhouse Gases)

Following from the idea of a museum collection I have presented the two main ingredients of fossil fuel that cause climate change, namely coal and oil, opposite each other. The coal specimens were laser cut with a map of the Southern Ocean, with Antarctica at the centre and various graphs. Coal is formed over millennia through the fossilisation of carbon, which originates from plant material. Similarly, the fossilisation of shells and the skeletons of marine organisms that settled on the ocean floor formed calcium carbonate over millennia. Just as the fossils of land-dwelling animals can be found embedded in rock, so too can the remains of marine animals be found in calcium carbonate deposits. My lasered coal pieces reference the fossils found in nature.

Figure 7.
Fossil, Antarctic, 2016
Lasered coal nugget.

Figure 9.
Ecoline **(Detail)*,* 2016**
Porcelain, pins, vinyl.

My presentation of oil is in the form of used motor oil, which sits above a layer of seawater. Revealing the physical inability of the two to combine and the dark viscous nature of the used motor oil appears to overburden the clear transparent seawater below it. Ironically, the liquids are contained in a glass separator, typically used in science to separate liquids of varying densities. A distinct line separates the two liquids.

Ecoline

Ecocline**:** A cline from one ecosystem to another, showing a continuous gradient between the two extremes.[20]

Ecoline: Neologism.
My own definition for the purposes of this text is that it is an environmental boundary that divides two spaces. My processes and materials complement transitions between the ocean and atmosphere and materialise as a visual manifestation of their connection.

I use the term ecocline when referencing the environment and ecoline when referencing the gallery.

The Council for Scientific and Industrial Research (CSIR) conducts extensive research in our oceans. Some of the tests done around South African coasts are received via satellite from an ocean glider. What caught my attention when first introduced to the ocean glider was that this vessel was measuring data specifically related to climate change whilst itself not emitting any carbon dioxide in the process. It is run remotely and powered by wave motion and solar energy, and because there are no humans on board can be sent into the ocean for months at a time. Its function is to record and relay data, via satellite, that measures the health of the ocean.

This vehicle has two parts to it: a boat, which floats on the surface, and a wing section below the surface, which enables it to propel itself forward. The vertical movement of the boat, caused by the waves, creates the forward motion. An “umbilical cord” connects the two parts. What happens on the surface of the water effects change below. Similarly,

20 http://www.oxforddictionaries.com/definition/english/ecocline

what goes on above the surface of the water – the emission of anthropogenic CO_2 through the burning of fossil fuels – affects the water below.

Lines have multiple meanings: in this context they can plot a physical course along which a vessel moves, describe the contour of the ocean floor, or mark a boundary. Lines can be found in an ecosystem as part of a living entity, hollow tubes or vessels carrying vital blood or sap, but they can also be points that connect one thing to another, acting as conduits (Weintraub 2012: 35). The ocean appears different when viewed from land than it does when viewed from above. From land, a line appears as a horizon or edge that can be interrupted when you float on it or when you immerse yourself in it. When one goes under the water this subterranean layer is quite different to how it is perceived from above. It is sometimes visible or revealing when the ocean is translucent and clear and at other times invisible, or concealing, depending on the clarity of the water. This clarity can become turbid from swirled sand and sediment that is the result of wave and current action, or turbidity can be caused by high numbers of phytoplankton[21] in the water. The boundary between these two environments is constantly changing – the merging of one into the other. As the liquid ocean swells, so the gaseous atmosphere shifts to accommodate it. However, in the case of ocean acidification the composition is altered by the excessive carbon dioxide that is being absorbed into it: the gas is in a state of ecocline and moves from the air into the ocean. What happens on and above the surface of the water affects the ocean below.

21 I mention Quon as her art stems from the intimate relationship she has with the ocean. She shows that cloudy water can be both exhilarating - through immersion in its living world - and frightening - because of the dangers rendered invisible by the turbidity of the water.

The video material that I obtained from the action cameras positioned on the ocean glider for the work *Ether (2015)* had no camera operator. The glider itself does the panoramic scanning in my videos. The mechanics of the glider became the operator that focused and framed the shots and also located the glider in the ocean in a specific place. Photographer and writer Victor Burgin posits that panoramic scanning with a digital camera results in an “acompositional” frame. He describes a “theoretical vision”, as the camera operator is not assembling or composing the image; instead, a mathematical calculation assembles the final image. Due to the absence of the operator “… there is no parallax, there is no differential movement between foreground, middle-distance and background” (Burgin 2008: 92). Factors of computation and programing, robotics and engineering are not visible or considered in the video, which is only concerned with capturing an image of the space.

This obscurity or lack of parallax[22] can be found in my chosen materials, which merge from one state to another, from a liquid to a solid through the process of moulding. It can also be seen in the blurring of boundaries between the areas of art and science and in the physical location of the ecocline where my artwork *Ether* was filmed. It is also manifest in the transformations in my work that came about through conversations and information I had from the scientists. And I, like the scientists who rely on the ocean glider to receive their data, rely on the ocean glider to acquire video material for my artwork.[23]

22 Parallax is when the position or direction of an object appears to differ when viewed from different positions.

23 Schedules of the engineers, who affix the cameras to the ocean glider, had to be considered as to when I could receive the raw video with which to create the artwork. Since the gliders generally go out for long stretches at a time, it is only feasible to have the cameras attached when sea trials are conducted over a few days. In this way I avoided having the cameras out for months at a time.

Figure 10 and 11.
Disperse (after Gonzalez-Torres) (Detail)**,** 2016
Moulded calcium carbonate.

My ecoline is a threshold between air and water in which movement occurs. It is also where the inhabitants of those realms meet and can move across and between those boundaries, be they human, animal or microorganism. It is a common ground where the separate inhabitants can meet and interact in a mutually beneficial way. Perhaps if humans could find a similar ecoline for a mutually beneficial relationship with nature there would be understanding that even the smallest of creatures have a role to play in the food chain. Philosophers like Aristotle and Plato, amongst others, reinforced and expanded the hierarchical ladder of speciation that has persisted through much Christian doctrine and is deeply embedded in the human psyche through the chain of being or ladder/stairway of nature (Lovejoy 1942: 183). It was further reinforced by Carl Linnaeus in his *System Natura*, which arranged species by their complexity and placed humans in a position superior to animals, plants and minerals. Historically, a mutually beneficial relationship between humans and the environment has not been a priority, but this position of dominance over the species below results in a separation of humans from the biosphere. When anthropogenic emissions start to affect organisms at the bottom of this food chain it is hard to imagine how this interdependence will not be affected.

Disperse

Distribute or spread over a wide area.
Go or cause to go in different directions.
(With reference to gas, smoke, mist, or cloud) thin out or cause to thin out and disappear.
Physics Divide (light) into constituents of different wavelengths.
Denoting a phase dispersed in another phase, as in a colloid.[24]

Cuban born Felix Gonzalez-Torres is described by author Nancy Spector (1996: viii) as a socially provocative artist. I used Spector's investigation of Gonzalez-Torres's work to inform my own artistic practice. Spector describes how travel can affect change in the work *Candy Spills*, in which Gonzalez-Torres arranged a pile of candy in the corner of the gallery, or flat on the floor in a rectangular shape. He engaged with the viewers in a collaborative way by inviting them to pick up a piece and take it away with them.

> Allusions to travel are embedded in the circulatory nature of this endlessly replaceable work. Premised on physical accessibility, public dispersal and continuous renewal, the paper stacks and candy spills literally give of themselves, yielding to the touch of the viewer. Gonzalez- Torrez describes this phenomenon as "one enormous collaboration with the public" in which the pieces "disperse themselves like a virus that goes to many different places – homes, studios, shops, bathrooms, whatever." (Spector 1996: 57)

Of central importance here is the concept of travel, of moving from one environment to another. Spector's observation of Gonzalez-Torres's work is that when something travels, there can be "change" in how it is viewed (Spector 1996: 56). She writes that a voyage

24 http://www.oxforddictionaries.com/definition/english/disperse

is a rupture – both leaving and returning – and this rupture may produce an altered position. The space between leaving and returning "permits the process of transmutation so critical to the concept of travel to occur" (Spector 1996: 57). Working with this notion of change provokes the question, can the action of travel also promote a shift in environmental awareness, a sort of travel parallax?

The travelling fragments of the whole, now in the hands of the viewers in Gonzales-Torres's work, can now move into multiple unpredictable spaces (Spector 1996: 58). There is also an act of giving inherent in the work, which can be viewed as generous, a generosity that may prompt the viewer to pay particular attention to what they are holding. Here, by giving away a souvenir, an intimacy can occur within the work. The notion of keepsake or souvenir, a memory of a trip or journey, plays out here where the individual or viewer takes something to remind them of a particular experience or "encounter with the world" that they have had (Spector 1996: 65). Gonzalez-Torres breaks down the notion of a public sculpture as one that is cast in bronze or carved from marble and replaces it with one that is shared and disposable and can constantly be remade.

Gonzalez-Torres uses the notion of travel as a metaphor to engage with his viewer. I aim to show that art can create awareness by using Gonzalez-Torres as a reference point: I hope to have an object move from the gallery into the public space through the viewer's engagement with the work, illiciting a response of consideration that leads to an awareness of the increasingly acidic oceans[25]. Engagement with many objects and many viewers could disperse awareness into the greater public arena, provoking questions as visitors move shells out of the gallery.

25 In a similar way the artist Jane Quon's art aims to engage the viewer but not be controlling, with the viewer "stepping forward, metaphorically, to make the connection" (Quon 2005: 187).

In my work titled *Disperse (after Gonzalez-Torres)* (2016), (in Figure 12) the viewer is offered the opportunity to choose whether or not they would like to engage with the work. "Its contents altered with each new venue, the look of the exhibition was entirely transformed, making manifest one of the most familiar tropes associated with the journey – that travel promotes change" (Spector 1996: 56). I enlarged the pteropod shell to a size that can fit in the palm of an adult's hand. The texture and quality of the calcium carbonate is silky smooth and when picked up leaves a white residue on the fingers, a trace that rubs off. There is a fragility to the shells, which are moulded by hand and can be easily broken. Casting the shell in calcium carbonate, the very substance that is being depleted by ocean acidification, brings attention to the object's composition. While they are cradled in the hand there will be a focused, intimate attention on that which is being held.

If a viewer chooses to keep one with them as they leave the gallery space, they will be carried and dispersed from the general pile to an individual and particular location, protected by the hands of the viewer. Because climate change can be presented as a generalised and overwhelmingly disparate issue, by making it particular and individual I hope to illicit an effective response from the viewer. There is a play here between putting a shell back in the ocean, as opposed to the more usual pastime of collecting shells and taking them from the shoreline. While Gonzalez-Torres's work is "endlessly" replenished with commercially produced and readily available sweets, my shells are not, drawing attention to a finite resource.

Figure 12.
Dissolve I, 2015
Video, 5.5 minutes.

In *Candy Spills* there is a physical connection with the viewer through the ingestion of the sweet into the body, whilst my connection with the body of the viewer is more tactile. Gonzalez-Torres's work can be described as intimate and personal as it deals with the mourning and loss of his partner. My work is not about a personal loss or mourning, but about the potential loss of these organisms, and empathy is evoked by the intimacy of holding the shell.

Dissolve

(With reference to a solid) become or cause to become incorporated into a liquid so as to form a solution.[26]

My work *Dissolve I* is informed by the work of Buster Simpson, who attempted to neutralise the waters of the Hudson River from the effects of acid rain by throwing large discs of limestone into it in his work *The Hudson Headwaters Purge* (1991). Simpson states, "As metaphor, it dramatises the crisis of person and planet as one; acid indigestion, acid rain – a connection the media picked up on when they coined the titles 'River Rolaids' and 'Tums for Mother Nature'" (Beardsley 1984: 268). He acknowledges that the metaphorical aspect to this work is that the "pill" is not the cure; by his action of adding limestone to the river he is not only trying to solve the problem, but is also highlighting the problem itself.

Figure 13. Buster Simpson. *Hudson River Purge*. 1983-1991. Soft limestone disks, 3"x 24" diameter.

26 http://www.oxforddictionaries.com/definition/english/dissolve

Figure 14 - 18.
Times Four, 2016
Installation
Shipping pallets, calcium carbonate and coal dust cubes.


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Figure 19.
31 Tons per Second, 2016
Digitial animation.

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My pill for the ocean, like Simpson's pill for the river, is in the shape of a pteropod shell cast out of calcium carbonate. In my work *Dissolve I* (2015) this compound is needed to make the oceans less acidic, and is also necessary for shell production. It is thrown into the ocean and left to dissolve. The breaking down of the solid form to a liquid state is not only a chemical process but also a conceptual merging of one state into another. I documented this dissolution through video until the compound appears as only a murky white cloud in the water. There is a change of form from one state to another, from a solid to a liquid, which is a reversal of the state in the moulding process, from liquid to solid. A mushroom-shaped bubble of water envelopes the shell as it enters the water, where the process of dissolving begins, and its particles begin to dissipate uniformly into the sea. Bubbles escape from the shell as it absorbs water, which float upwards towards the surface, pulsating and beating as they are released. This sound, projected from the video, varies between a slow rhythm and a rapid staccato, beating its own drum.

In *Dissolve II* (2015), (Figure 14 & 15) another video installation, I again used calcium carbonate but this time in the ecocline where the shore meets the ocean. The white talc-like powder was cast into cubes and arranged on the sand, set out in blocks each made up of four by four rows. The grouping of the three larger cubes is such that there is a vacant space where the fourth grouping should be. As the tide moves up the beach the cubes gradually dissolve into the sea, allowing the incoming tide to reclaim the calcium carbonate and incorporate it into the sea. The white powder seeps into the water from the blocks. There is a sense of loss as the artwork disappears into the water, which is contradicted by the understanding that the compound will counteract the effects of ocean acidification and result in a beneficial outcome.

Dissolve II is shown in the gallery alongside a digital counter that is titled *31 Tons per Second* (2016)(Figure 21). This counter started counting at the beginning of the year 2016 and is counting at a rate of 31 tons per second. The whole of the Southern Ocean absorbs almost 2.7 million tons of carbon dioxide per day, or 111 600 tons per hour or 1860 tons per minute or 31 tons per second. In the artwork *31 Tons per Second* I have had a counter assembled that escalates as the seconds roll over.[27] This reality is reinforced by a second counter that also climbs, indicating global carbon dioxide emissions.[28] The escalation is so rapid that the numbers cannot be observed individually, although the speed at which the numbers move is visually captivating and adds an even greater sense of urgency to the total figure.

For every cubic ton of coal burnt, 4 cubic tons of calcium carbonate will need to be added to the ocean to counteract the harmful effects of the carbon dioxide emissions.[29] *Times Four* (2015) is a work that includes 31 cubes of coal dust and 124 cubes of calcium carbonate arranged on wooden shipping pallets (Figure 17). The ratio of coal to calcium carbonate is indicated on the individual pallets. This work is incomplete, as only once all the calcium carbonate blocks in the gallery space are taken to the shoreline and dissolved in the ocean will the work be complete. A second video will document the process. The 31 blocks of coal will be recycled into another artwork. The title of one work *31 Tons per second* relates to the number of blocks in another work *Times Four*, connecting the works to each other. The same blocks are in the video as those sitting on the shipping palettes in the gallery. The relationship between the art works shows connection and links them to each other. As in an environment, links can always be found.

27 See appendix A. Correspondence email

28 This and other captivating statistics available at http://www.worldometers.info

29 See appendix B. Correspondence email

Ether

Chemistry: A pleasant-smelling colourless volatile liquid that is highly flammable. It is used as an anaesthetic and as a solvent or intermediate in industrial processes. Alternative names: diethyl ether, ethoxyethane; chemical formula: $C_2H_5OC_2H_5$
(also aether) chiefly literary: the clear sky; the upper regions of air beyond the clouds: nasty gases and smoke disperse into the ether
(also aether)Physics, archaic: A very rarefied and highly elastic substance formerly believed to permeate all space, including the interstices between the particles of matter, and to be the medium whose vibrations constituted light and other electromagnetic radiation.[30]

The inability to contain or locate specific amounts of CO_2 presents similar difficulties to ether's historic invisibility. CO_2's connections to climate change are also not visible or clear. This lack of clarity makes it difficult to engage with the problems of climate change and ocean acidification. CO_2, like ether, disperses from "the upper regions of air beyond the clouds" (as described above), and is absorbed by the ocean below. It is the nasty gas that also "permeates all space".

30 http://www.oxforddictionaries.com/definition/english/ether

It is difficult to directly link climate change, CO_2 and globalisation, but Pamela Lee asks the question "… how do you make a world picture? How do you present the workings of the world as being fluid and smooth or fractured and discordant; efficient and close to hand or grossly asymmetrical, stricken by distance and disparity?" (2012: 78). Lee interrogates this dilemma through the photographic works of artists Andreas Gursky and Allan Sekula in her book *Forgetting the Art World*. Lee connects the containers that Gursky photographs in *Salerno* (1990),[31] which are located on land, with those found on a container ship out to sea photographed by Sekula. Sekula brings images of ships carrying containers across the ocean into the public space of the gallery and bears witness to the usually unseen journey of the container ships. Lee makes a metaphorical connection to consumerism and globalisation through the containers' capacity to store and transport consumer goods across the globe. I look to make these connections of globalisation[32] to climate change by bringing the real-time physical co-ordinates of the ocean glider into the gallery.

31 Gursky has an all-over sharp focus rather than one specific focal point, a methodology he uses often in his works. It is an example of "realism for current times" in that everything is available for visual consumption (Lee 2012: 477).

32 Lee interrogates the use of the word "globalisation" as being "amorphous" in that it is used so broadly yet it is inescapable and inevitable for global citizens. Finding the similarities of representation to globalisation in the art world is also examined (2112: 4,8).

Figure 20.
Ether, 2016
Video installation, 2.44 minutes.

In climate change, particular processes emit harmful gases into the air but the effect of these gases can be very general, and so the idea of the general and the particular is relevant in this context. In turn, particular weather events such as unprecedented storms and droughts are the result of general changes in the climate. Because of this uncertainty it is as if the causes and effects of climate change are ethereal, existing only in the air, invisible to the eye. In discussing the work of Andreas Gursky, Lee introduces the idea of ether:

> It's the "invisible hand" that guides all of Gursky's subjects. It's the unseen fluid that moves around and between, lubricating relationships between people and things while seeming to banish distances as a mere inconvenience. It's the crystalline envelope that equalizes all that it contains, as if to recall Marx, "all that is solid melts into air". What Gursky gives us, in a word, is what used to be called the "ether", a substance of no particular substance and a dream of transparency, everywhere and nowhere all at once. (Lee 2012: 77)

Like Lee, Carolyn Merchant also looks to Marx to link ecology and society. Social ecology is a commitment to reversing humanity's domination over nature and is enhanced by an equal commitment to addressing the unbalanced power struggle that plays out in class inequalities as well (1992: 145). I reference both Lee and Merchant as they make the unseen visual, in much the same way that I attempt to visually manifest the unseen gas, carbon dioxide.

Climate change is not a simple topic with simple solutions, but is caused by an intricate web of factors. To overcome this problem an equally intricate solution will have to be reached: governments, consumers, corporations, farmers and the general public will all have to make adjustments to how they live, and come together in a cohesive way. In *Three Ecologies*, Felix Guattari (2008) refers to the efforts that will have to be made to address this concern.

> The only true response to the ecological crisis is on a global scale, provided that it brings about an authentic political, social and cultural revolution, reshaping the objectives of the production of both material and immaterial assets. Therefore this revolution must not be exceedingly concerned with visible relation of force on a grand scale, but also take into account molecular domains of sensibility, intelligence and desire. (Guattari 2008: 20)

> … only an ethico-political articulation – which I call ecosophy – between the three ecological registers (the environmental, social relations and human subjectivity) would be likely to clarify these questions. (Guattari 2008: 19)

Figure 21.
Dissolve II, 2016
Video installation, 3.14 minutes.

Guattari shows the need for connectivity between the three ecological registers, which is also how Burgin brings together the general and the particular with the realisation that “There is no question of ‘choosing’ the local *against* the global – this is no longer an option, the global is *in* the local, in the phenomenological particles of everyday life” (Burgin 2008: 83).

In my artwork *Ether (2016),* two large videos of the surface of the ocean are screened. This is the video material obtained from the ocean glider that is situated between the ocean and the atmosphere. It is filmed on different days and shows the varying conditions of the surface of the ocean, one calm and quiet and the other choppier and rough. One of the videos shows the glider moving in a forward direction and the second video is shot from the back of the glider, showing glimpses of an ocean vessel in the distance. I have geographically located this work to a specific glider in the ocean with a live feed that is plotted on a screen, revealing the exact coordinates intermittently. The work presents the ocean to the viewer within the gallery space. There is a physical link to the glider on the ocean that may make issues of climate change and ocean acidification more accessible to the viewer. Watching the video in some instances leaves the viewer with an uncomfortable, unsteady feeling often associated with motion sickness.

Endnote

My aim for this exhibition is to bring awareness to the ongoing problem of climate change and more specifically to ocean acidification. Like my exploration of the two separate fields of art and science, the exhibition is the meeting point for more than one idea, in much the same way that some of the artworks relate and connect to each other, as in the case of *Dissolve I, Dissolve II, 31 Tons per Second* and *Four times*. I built in a connection with the future by having one of the works complete only after the exhibition has ended. Like ether and carbon dioxide, the viewer, an integral participant in this exhibition, only makes the connections possible through their presence. Aim to engage the viewer by bringing them into my ecocline, potentially enabling them to visually identify and move along the ecoline and thereby become aware of and hopefully concerned about ocean acidification.

Appendix

A
Hi Ingrid, so here are the steps of my calculation and its assumptions
Coal 47% carbon by weight
1000 kg coal = 470Kg Carbon
Atomic weight of carbon = 12
470Kg Carbon = 39.16 Kilo Moles of carbon
the neutralization of CO2 by carbonate in sea water is a 1:1 reaction 1 CO2 reacts with 1 carbonate (CO3) to produce 2 bicarbonate ions (2HCO3)
so 1 mole of CO2 requires 1 mole of CaCO3
Atomic weight of CaCO3 = 100
total mass of CaCO3 required to neutralize CO2 from 1 ton of coal = 39.16 x 100 = 3916 Kg
so basically you need 4x the weight of limestone to neutralize the CO2 from a given weight of coal

Hope this helps
Pedro

Dr. Pedro M. Scheel Monteiro
Head: Ocean Systems & Climate
CSIR-CHPC
15 Lwr Hope Rd, Rosebank
Cape Town, 7700South Africa
Tel: +27 21 8882528
mobile: +27 82 4488844

www.socco.org.za
http://socco.org.za/team/dr-pedro-monteiro/
http://www.researchgate.net/profile/Pedro_Monteiro8
https://scholar.google.co.za/citations?user=gk4JdKYAAAAJ&hl=en

B
Dear Ingrid
The Southern Ocean takes up about 1PgC/y of anthropogenic CO2. This means that over the whole SO about 2.7 million tons of carbon are added per day. This is about 31 tons of carbon /second.

Dr. Pedro M. Scheel Monteiro
Head: Ocean Systems & Climate
CSIR-CHPC
15 Lwr Hope Rd, Rosebank
Cape Town, 7700South Africa
Tel: +27 21 8882528
mobile: +27 82 4488844

www.socco.org.za
http://socco.org.za/team/dr-pedromonteiro/
http://www.researchgate.net/profile/Pedro_Monteiro8
https://scholar.google.co.za/citations?user=gk4JdKYAAAAJ&hl=en

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World Data centre For Greenhouse Gases

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Times Four (Detail)**,** 2016
Installation
Shipping pallets, calcium carbonate and coal dust cubes.

Ecoline, 2016.
Porcelain, pins, vinyl.

Catalogue

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